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PTO/SB/05 (12/97)

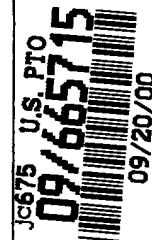
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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No. 80398.P331Total Pages 2First Named Inventor or Application Identifier Scheel, et al.Express Mail Label No. EL234218135US

ADDRESS TO: Assistant Commissioner for Patents
 Box Patent Application
 Washington, D. C. 20231

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. X Fee Transmittal Form
(Submit an original, and a duplicate for fee processing)
2. X Specification (Total Pages 210)
(preferred arrangement set forth below)
 - Descriptive Title of the Invention
 - Cross References to Related Applications
 - Statement Regarding Fed sponsored R & D
 - Reference to Microfiche Appendix
 - Background of the Invention
 - Brief Summary of the Invention
 - Brief Description of the Drawings (if filed)
 - Detailed Description
 - Claims
 - Abstract of the Disclosure
3. X Drawings(s) (35 USC 113) (Total Sheets 10)
4. X Oath or Declaration (Total Pages 5) (UNEXECUTED)
 - a. Newly Executed (Original or Copy)
 - b. Copy from a Prior Application (37 CFR 1.63(d))
(for Continuation/Divisional with Box 17 completed) (**Note Box 5 below**)
 - i. **DELETIONS OF INVENTOR(S)** Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
5. Incorporation By Reference (useable if Box 4b is checked)
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6. Microfiche Computer Program (Appendix)

12/01/97

- 1 -

PTO/SB/05 (12/97)

09/20/00

7. ☐ Nucleotide and/or Amino Acid Sequence Submission;
(if applicable, all necessary)
a. ☐ Computer Readable Copy
b. ☐ Paper Copy (identical to computer copy)
c. ☐ Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. ☐ Assignment Papers (cover sheet & documents(s))
9. ☐ a. 37 CFR 3.73(b) Statement (where there is an assignee)
☐ b. Power of Attorney
10. ☐ English Translation Document (if applicable)
11. ☐ a. Information Disclosure Statement (IDS)/PTO-1449
☐ b. Copies of IDS Citations
12. ☐ Preliminary Amendment
13. ☒ Return Receipt Postcard (MPEP 503) (Should be specifically itemized)
14. ☐ a. Small Entity Statement(s)
☐ b. Statement filed in prior application, Status still proper and desired
15. ☐ Certified Copy of Priority Document(s) (if foreign priority is claimed)
16. ☐ Other:

17. **If a CONTINUING APPLICATION**, check appropriate box and supply the requisite information:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP)
of prior application No:

18. **Correspondence Address**

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Fee Code	Fee (\$)	Fee Code	Fee (\$)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	_____
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	_____
139	130	139	130	Non-English specification	_____
147	2,520	147	2,520	For filing a request for reexamination	_____
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	_____
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	_____
115	110	215	55	Extension for response within first month	_____
116	380	216	190	Extension for response within second month	_____
117	870	217	435	Extension for response within third month	_____
118	1,360	218	680	Extension for response within fourth month	_____
128	1,850	228	925	Extension for response within fifth month	_____
119	300	219	150	Notice of Appeal	_____
120	300	220	150	Filing a brief in support of an appeal	_____
121	260	221	130	Request for oral hearing	_____
138	1,510	138	1,510	Petition to institute a public use proceeding	_____
140	110	240	55	Petition to revive unavoidably abandoned application	_____
141	1,210	241	605	Petition to revive unintentionally abandoned application	_____
142	1,210	242	605	Utility issue fee (or reissue)	_____
143	430	243	215	Design issue fee	_____
144	580	244	290	Plant issue fee	_____
122	130	122	130	Petitions to the Commissioner	_____
123	50	123	50	Petitions related to provisional applications	_____
126	240	126	240	Submission of Information Disclosure Stmt	_____
581	40	581	40	Recording each patent assignment per property (times number of properties)	_____
146	690	246	345	For filing a submission after final rejection (see 37 CFR 1.129(a))	_____
149	690	249	345	For each additional invention to be examined (see 37 CFR 1.129(a))	_____
Other fee (specify) _____					_____
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SUBMITTED BY:

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Signature Maria McCormack Sobrino Date September 20, 2000

Reg. Number 31.639 Deposit Account User ID 02-2666
(complete if applicable)

"Express Mail" mailing label number: EL234218135US

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UNITED STATES PATENT APPLICATION
FOR
A METHOD AND SYSTEM FOR MAINTAINING A LISTENER'S
LINK TO A CONTROLLER

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September 20, 2000

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A METHOD AND SYSTEM FOR MAINTAINING A LISTENER'S LINK TO A CONTROLLER

This application claims benefit of U.S. Provisional Application No. 60/155,305 filed September 21, 1999.

FIELD OF THE INVENTION

The present invention relates generally to audio, video, audio/video interconnected systems for home and office use. More particularly, the present invention relates to communication management in such systems.

BACKGROUND OF THE INVENTION

With the development of consumer electronic audio/video (A/V) equipment, and the advance of digital A/V applications, such as consumer A/V device control and signal routing and home networking, various types of data in various formats can now be transferred among several audio/video control (AV/C) devices via one digital bus system. However, many current systems do not have sufficient bandwidth resources to transfer and display all the different types of data at the same time.

Typical computer systems solve the bandwidth problem by increasing the bandwidth of the system bus to handle all of these forms, types and amount of data. As a result, as users request more types of information such as in multimedia applications, the system bus has become more clogged with information other than information directly utilized and needed by the main processor.

Many computer systems incorporate at least two buses. A first bus, commonly referred to as a memory bus, is typically used for communications between a central processor and a main memory. A second bus, known as a peripheral bus, is used for communications between peripheral devices such as graphics systems, disk drives, or local area networks. To allow data transfers

between these two buses, a bus bridge is utilized to "bridge" and thereby couple, the two buses together.

One example of a high-speed bus system for interconnecting A/V nodes, configured as a digital interface used to transport commands and data among interconnecting audio/video control (AV/C) devices, is the IEEE 1394 standard serial bus implemented by IEEE Std 1394-1995, *Standard For A High Performance Serial Bus*, August 30, 1996 (hereinafter "IEEE 1394 standard") and related other 1394 standards.

The IEEE 1394 standard is an international standard for implementing a high-speed serial bus architecture, which supports both asynchronous and isochronous format data transfers. The IEEE 1394 standard defines a bus as a non-cyclic interconnect, consisting of bus bridges and nodes. Within a non-cyclic interconnect, devices may not be connected together so as to create loops. Within the non-cyclic interconnect, each node contains an AV/C device, and bus bridges serve to connect buses of similar or different types.

The primary task of a bridge is to allow data to be transferred on each bus independently without demonstrating performance of the bus, except when traffic crosses the bus bridge to reach the desired destination on the other bus. To perform this function, the bridge is configured to understand and participate in the bus protocol of each of the buses.

Multi-bus systems are known to handle the large amounts of information being utilized. However, communication between buses and devices on different buses is difficult. Typically, a bus bridge may be used to interface I/O buses to the system's high-performance processor/memory bus. With such I/O bridges, the CPU may use a 4-byte read and write transaction to initiate DMA transfers. When activated, the DMA of a serial bus node generates split-response read and write transactions which are forwarded to the intermediate system backbone bus which also implements serial bus services.

Depending on the host system design, the host-adapter bridge may have additional features mandated by differences in bus protocols. For example, the host bus may not directly support isochronous data transfers. Also, the host-adapter bridge may enforce security by checking and translating bridge-bound transaction addresses and may often convert uncached I/O transactions into cache-coherent host-bus transaction sequences.

Each time a new device or node is connected or disconnected from an IEEE 1394 Standard Serial Bus, the entire bus is reset and its topology is reconfigured. The IEEE 1394 Standard Device Configuration occurs locally on the bus without the intervention of a host processor. In the reset process, three primary procedures are typically performed; bus initialization, tree identification, and self-identification. Within the IEEE 1394 Standard, a single node must first be established as the root node during the tree identification process in order for the reconfiguration to occur.

A conventional isochronous bus connection includes multiple buses, one or more bus bridges, a talker node, and one or more listener nodes. A talker node usually provides an isochronous data stream and forwards the isochronous data stream onto a bus. A listener node typically reads the packets from the isochronous data stream.

A typical method for establishing communication between the talker node and the listener node is to build isochronous bus connections from the talker node toward the listener node.

A problem with the maintenance communication between the talker node and the listener node is that when busIDs have changed, nodes need to be notified of this occurrence. Another problem associated with the maintenance isochronous stream is notifying listeners when isochronous bandwidth requirements have changed. One approach to notifying nodes of bandwidth changes in the talker is to initiate a broadcast event that would inform other nodes of the bandwidth-requirement

change. However, this approach is complicated and unnecessarily signals uninvolved controllers.

SUMMARY OF THE INVENTION

- A method of maintaining communications in a bus bridge interconnect including a plurality of buses linked by at least one bus bridge is described. The method includes receiving a change indication signal from a talker node, performing
- 5 an address resolution protocol in response to the change indication signal to find an updated node identification address("nodeID") for a listener node using an extended unique identifier ("EUI") of the listener node, and storing the updated listener nodeID with the listener node EUI.

BRIEF DESCRIPTION OF THE DRAWINGS

Features and advantages of the prevention invention will be apparent to one skilled in the art in light of the following detailed description in which:

Figure 1 is a block diagram of one embodiment for an interconnect topology;

5 **Figure 2** is a block diagram of a device of **Figure 1**;

Figure 3 is a block diagram of one embodiment for a 1394 standard bus bridge system;

Figure 4 is a block diagram of one embodiment for a 1394 bus bridge topology;

10 **Figure 5** is a block diagram of one embodiment for a looped bus bridge topology;

Figure 6 is a block diagram of one embodiment for bus bridge components;

Figure 7 is a block diagram of one embodiment for bus bridge isochronous transfer;

15 **Figure 8** is a block diagram of another embodiment for bus bridge isochronous transfer;

Figure 9 is a flow diagram of one embodiment of a method of maintaining a listener's link to a controller;

20 **Figure 10** is a flow diagram of another embodiment of maintaining a listener's link to a controller.

DETAILED DESCRIPTION

A method and system for maintaining a listener's link to a controller in a bus bridge system.

For purposes of explanation, in the following description, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be apparent, however, to one skilled in the art that the present invention can be practiced without these details. In other instances, well-known structures and devices are shown in block diagram form in order to avoid obscuring the present invention.

A machine-readable medium includes any mechanism for storing or transmitting information in a form readable by a machine (e.g., a computer). For example, a machine-readable medium includes read only memory ("ROM"); random access memory ("RAM"); magnetic disk storage media; optical storage media; flash memory devices; electrical, optical, acoustical or other form of propagated signal (e.g., carrier waves, infrared signals, digital signals, etc.); etc.

A communication mechanism, which may be used in an IEEE 1394 environment, provides communication connection maintenance for isochronous connection. An isochronous bus connection may include a talker and multiple listeners. The term talker and talker node will be used interchangeably herein. Likewise the term listener and listener node will be used interchangeably herein.

In one embodiment, the mechanism allows the listener to verify the source of a message received from a controller where the controller nodeID has changed by identifying a node according to an extended unique identifier ("EUI") of the controller.

In one embodiment, the mechanism allows the controller to update a nodeID of a listener by identifying an EUI of the listener. In one embodiment, the controller receives a net change indication for a listener and the controller performs an address resolution protocol ("ARP") to determine the nodeID of the listener.

In one embodiment, the mechanism allows the listener to communicate property changes by a talker to a controller.

Figure 1 is a block diagram of one embodiment for an interconnect topology 100. Referring to **Figure 1**, server 102 is connected to a wide area network (WAN) 110 and to a bus bridge 170. The bus bridge is interconnected to a number of audio, video, and/or audio/video devices, 120, 130, 140, 150, and 160. In one embodiment, the devices (120-160) are connected to bus bridge 170 via the IEEE 1394 standard serial bus. Server 102 may be any device that is capable of connection to both a bus bridge 170 and wide area network 110, such as, for example, a personal computer or a set-top box. In one embodiment, network 110 may be a wide area network, such as, for example, the Internet, or a proprietary network such as America Online®, CompuServe®, Microsoft Network®, or Prodigy®. In addition, WAN 110 may be a television communications network. Server 102 includes a network interface which communicates with WAN 110.

Topology 100 includes high speed serial bus 180a and 180. In one embodiment, serial bus 180 is the IEEE 1394 standard serial bus. Topology 100 includes various consumer electronic devices 120-160 connected via the high speed serial bus 180 to bus bridge 170. The consumer electronic devices 120-160 may include, for example, a printer, additional monitor, a video camcorder, an electronic still camera, a video cassette recorder, digital speakers, a personal computer, an audio actuator, a video actuator, or any other consumer electronic device that includes a serial interface which complies with a serial interface standard for networking consumer electronic devices — for example, the IEEE 1394 standard. Topology 100 may be contained within a home or office. Bus bridge 170 is used to connect devices 120-160 in which devices 120-160 may be physically located within different rooms of the home or office. Although the original IEEE bus standard is designed for use with a cable interconnect, any communication media may be used such as radio frequency (RF) communication or the like.

Figure 2 is a block diagram of a device 120. Referring to **Figure 2**, device 120 may be a laser printer, digital camera, set-top box, or any other appropriate consumer electronic device capable of being connected via a high speed serial bus 180. In one embodiment, the device 120 includes a controller 202, memory 208, and I/O 210, all connected via bus 215. Memory 208 may include, for example, read only memory (ROM), random access memory (RAM), and/or non-volatile memory. I/O 210 provides connection with wide area network 110, bus bridge 170, and another peripheral device (130-160).

In one embodiment, I/O 210 is a serial bus interface that complies with a serial interface standard for networking with consumer electronic devices (120-161) and bus bridge 170 within topology 100. For example, the serial bus interface and topology 100 may use the IEEE 1394 standard serial bus. I/O 210 provides for receiving signals from and transmitting signals to other consumer electronic devices (130-160) or bus bridge 170.

Memory 208 provides temporary storage for voice and data signal transfers between outside network 110 and topology 100. In addition, memory 208 may buffer digital voice and data signals received by I/O 210 from WAN 110 before signals are transmitted onto IEEE 1394 standard bus 180.

Controller 202 controls various operations of device 120. Controller 202 monitors and controls the traffic through the device 120 to and from topology 100 and WAN 110.

Device 120 I/O 210 may have one or more physical ports. A single port device discontinues the bus along the given branch of the bus, whereas devices with two or more ports allow continuation of the bus. Devices with multiple ports permit a daisy chained bus topology, even though the signaling environment is point-to-point. That is, when a multi-port node receives a packet of data, the data is detached and retransmitted to the necessary port as indicated within the data. The configuration is performed dynamically as new devices are attached and/or removed from bus 180.

The 1394 standard bus protocol is designed to support peer-to-peer transfers between devices. This allows serial bus devices to transfer data between themselves without intervention from a computer system or host system. This allows high throughput between devices without affecting the performance of the computer system. Thus, a video camera may be set up to transfer between itself and a video cassette recorder without accessing a computer system.

Figure 3 is a block diagram of one embodiment for a 1394 standard bridge bus system 400. Referring to **Figure 3**, system 400 includes bridge 402 which connects two or more buses 408 and 410. Bus 408 and 410 may be the same or different types of buses. For example, bus 408 may be a 1394 standard serial bus and bus 410 may be a different high performance bus. The 1394 standard bus architecture limits the number of nodes or devices 310 on a bus 263 and supports multiple bus systems via bus bridge 402.

The control and status register (CSR) architecture, ISO/IEC 13213 (ANSI/IEEE 1212), *Information systems-Control and Status Registers (CSR) Architecture Microcomputer Buses*, defines the 1394 standard bus addressing structure, which allows approximately 2^{16} nodes (404, 406, 412-420). The CSR standard defines their registry, their functionality, and, where appropriate, where they appear in the address space.

Figure 3 is the simplest instance of a bus topology in which the net has one bus bridge. **Figure 4** illustrates a net that may have more than one bus bridge and, when so structured, is hierarchical in nature. **Figure 5** illustrates a network whose physical topology may have loops, but whose loops are electronically disabled to generate a hierarchical structure. In the description that follows, a collection of multiple buses connected through a bus bridge is referred to as a "net".

Figure 4 is a block diagram of one embodiment for a 1394 bridge bus topology 500. Referring to **Figure 4**, topology 500 has one prime portal 504 and one or more alpha portals 506 and 508. The primary bus 525 has exactly one prime portal 504 and the secondary buses 527, 529, 531, 533, and 535 have exactly one alpha portal each —

506, 508 and 510. Each bus 525-535 may have any number of secondary portals. An alpha portal is on the path to a prime portal. Any portal not a prime portal or an alpha portal is a secondary portal. The prime portal or the alpha portal may be referred to as a primary portal.

5 Within an interconnect topology 500, the bridge portal with the largest portal ID identifier is elected to become the prime portal 504. In an alternate embodiment, the bridge portal with the smallest portal ID identifier is elected to become the prime portal 504. Each portal appears as a node on its attached bus. The bus with the prime portal 504 is termed the primary bus 525 and other buses 527-535 are termed
10 secondary buses. On secondary buses 527-535, the bridge portal that leads to the primary bus 525 is called the alpha portal (506, 508). After a bridge bus interconnect is configured, any node within the interconnect may be accessed by its unique 16-bit node identification address. The node identification address contains the bus ID and the local ID components. Referring to **Figure 4**, the bus identification IDs of nodes
15 512-524 are indicated by the letters a, b, and c and the local ID is indicated by the numbers 0-4.

 In one embodiment, alpha portal 504 is responsible for rejecting missed address asynchronous data packets by accepting these requests and returning error reporting responses. The previous and current prime and alpha portal identifiers are
20 used to classify nodes when an interconnect topology changes, and the alpha portal is the isochronous clock reference for other nodes on the bus.

 Bus bridge topology 500 may change and be established dynamically during operation of bus bridge system 500. In one embodiment, the bus bridge topology 500 is established during net refresh. Within topology 500, portals selectively route
25 packets. Asynchronous routing tables are stable until topology 500 changes during a net refresh or net reset operation. Asynchronous routing tables are dynamic and are changed by their asynchronous connect and disconnect operations of the protocols.

Figure 5 is a block diagram of one embodiment for a looped bus bridge topology 600. Referring to **Figure 5**, during node 300 addition, portal 606 may be added to the topology 600 forming a loop. Thus, a path exists from a0-b4 through c0 back to a0. During initialization, the redundant portal 606 is disabled so that a hierarchical bus bridge topology remains.

In an alternate embodiment, cyclical net topologies may be allowed. In this alternate embodiment, software routines may partially activate the redundant bridge 606 and allow a shortest path routing between nodes. For example, traffic between bus a 605 and bus c 615 may be efficiently routed without introducing deadlocks.

Figure 6 is a block diagram of one embodiment for bus bridge components 700. Referring to **Figure 6**, bus bridge components 700 are maintained within each portal in which bus "a" to bus "b" components 702 and bus "b" to bus "a" components 704 are independently maintained. Components 700 also contains shared microprocessor and RAM 706.

Asynchronous and isochronous packet transfers may not acquire a bus at the same time. Therefore, asynchronous packets are placed in request queues 708, 720 and response queues 710, 722. The asynchronous packets are selected for transfer at times when isochronous packets are not being transferred. Isochronous packets are received and time stamped 712, 724. Time gates 718, 730 release the isochronous packets 714, 726, together with common isochronous packet (CIP) headers 716, 728, at fixed times. Routing tables select which asynchronous and isochronous packets are accepted and queued for adjacent bus delivery.

Topologies may share physical buffer space rather than implementing physical distinct stacks subject to the following: bus "a" to bus "b" and bus "b" to bus "a" queues operate independently, response processing is never blocked by queued requests, and asynchronous subactions and isochronous packets are forwarded independently. Topologies may block a request behind the previously queued

response without generating potential deadlocks; however, requests and responses are processed independently.

Isochronous routing decisions are made by checking the isochronous packet's channel number. Accepted packets are converted and retransmitted on the adjacent bus with newly assigned channel numbers, speeds, and CIP-header and, when a CIP-header is provided, time-stamp parameters 716, 728 from the CIP-header. CIP-headers may be pre-appended to some isochronous packets to further describe their format and function and desired presentation time. When the packets incur delays while traversing through a bridge, then presentation time must be adjusted to compensate for this delay. CIP headers are defined in ISO/IEC 61883 specification. Isochronous packets received in cycle n are forwarded to the adjacent bus in cycle $n+k$ where k is an implementation dependent constant. Messages may be passed around one bus or pass through a bridge by writing to a standardized message location 732, 734, 736, 738 on a bridge's portal. This allows bus-interconnect topologies to be restored while freezing, or discarding when necessary, previously queued subactions.

Distribution of clock-sync information 740, 742 from the primary-bus source is performed by placing calibration information in isochronous-clock pseudo queues before forwarding this information to the clock master on the adjacent portal. In one embodiment, clock-sync information flows from the primary bus downward, so that only one clock-sync pseudo queue may be required.

In support of bus bridges, each node has two nodeID addresses: physical ID address and virtual ID address. A physical nodeID has a $3FF_{16}$ valued bus ID; a virtual nodeID has smaller bus ID addresses. In the absence of bus bridges, all nodes are accessed through their physical addresses. In the presence of bus bridges, the physical address is used to configure the node and the virtual address is normally used thereafter.

Directed-asynchronous routing decisions are made by checking the destination ID addresses of pass-through packets. Accepted packets are directly routed to the bridge's opposing port. In addition, an asynchronous quarantine is maintained which selectively enables forwarding of a request sub-action based on the local identification of a bus-local requester. A set of legacy bits identifies local nodes which requires specific processing of sourced requests and returning responses.

Figure 7 is a block diagram of one embodiment for bus bridge isochronous transfer. Referring to **Figure 7**, isochronous connections involve one talker 802 and one or more multiple listener 804/controller 806 pairs. Isochronous packets are accepted based on the current channel identification and are retransmitted on the adjacent bus with a new channel ID. A controller 806 establishes an isochronous connection. The isochronous connection enables communication between talker 802 and listener 804. An isochronous connection may be made between a single talker 802 and multiple listeners 804.

Isochronous non-overlaid connections proceed as follows: controller 806 sends a message to the final portal 810a in the path towards listener 804. If necessary, portal 810a forwards the message to the first portal on the path between the listener 804 and talker 802 (in this case, portal 808a). Portal 808a acquires isochronous resources from IRM 825 on its bus. IRM 825 may be located within portal 808a or any other node. The message is forwarded towards the talker bus 805, which results in the message being received by portal 808b. Portal 808b acquires the isochronous resources in IRM 825 and updates the oPCR within talker 802. The message is forwarded back toward listener 804, which results in it being received by portal 808a. Portal 808a updates the iPCR on listener 804 so that it listens to the correct channel. Portal 808a forwards a message-complete indicator to controller 806.

In one embodiment, a disconnect message is sent from controller to portal 810b. Portal 810b forwards the message to portal 808a which updates the iPCR on

listener 804 and releases the IRM resources associated with bus 807. The message is forwarded to portal 808b. The oPCR of talker 802 is updated in order to stop transmission. Portal 808b updates the IRM resources associated with bus 805. A completion message is then sent from portal 808b to controller 806.

5 In an alternate embodiment, controller 806 sends a disconnect message toward listener 810a, which results in the message being received by portal 810a. Portal 810a forwards the message to portal 808a (the talker side portal of listener 804). Portal 808a forwards the message towards talker 802, which results in the message being received by portal 808b. Portal 808b updates the oPCR of talker 802 in order to stop
10 transmission. Portal 808b accesses IRM 825 to release isochronous channel and bandwidth resources associated with bus 805. Portal 808b forwards the message toward listener 804, which results in the message being received by portal 808a. Portal 808a updates the iPCR of listener 804 in order to stop listener 804 from listening. Portal 808a updates the IRM isochronous resources associated with bus
15 807. Portal 808a then sends a completion message to controller 806.

Figure 8 is a block diagram of another embodiment for a bus bridge isochronous transfer. Referring to **Figure 8**, a common connection isochronous transfer is illustrated. Talker 902 is connected by controller 906 to listener 904. In one embodiment, controller 906 may be on the talker bus 905, listener bus 915, or other
20 bus. Each listener 904 is associated with a controller 906. The controller 906 may be the same or different for the various listeners 904.

In the example of Figure 8, the connection message from controller 906 is processed by portal 912a in which it is found to have the same stream ID. This allows the new listener to listen to the previously established channel.

25 In one embodiment, a disconnect message is sent from controller 906 towards listener 904, which results in the message being received by portal 912a. Portal 912a updates the iPCR of listener 904 in order for listener 904 to stop listening. Portal 912a decrements its use count and returns a completion message to controller 906.

Figure 9 is a flow diagram of one embodiment of a method of maintaining listener's link to a controller. Referring to **Figure 9**, at processing block 1001, a controller 806 receives a change indication from a talker node 802. The received change indication may be net change signal, indicating that something has changed.

5 At processing block 1002, the controller 806 will perform an address resolution protocol ("ARP"). An ARP is a way of associating a nodeID with an EUI. Thus, the controller will perform an exhaustive search for a EUI matching the listener's EUI, EUI-64L. For example, the controller will search in a local bus bridge to see what buses exist. The controller 806 will then search each bus until it finds a matching
10 EUI. Then, the controller 806 will identify the nodeID associated with the matching EUI found by the controller as a result of its exhaustive search.

At processing block 1003, the controller will then store the updated listener nodeID, nodeID-64L', with the listener node EUI, EUI-64L. In one embodiment, the updated listener nodeID, nodeID-64L', is stored in a bus bridge portal, such as, for
15 example, bus bridge portal 810b. Each bus bridge portal has incoming and outgoing message queues so that it can process or modify or resend messages. Thus, modifications to messages sent by a talker 802 may be performed by bus bridge firmware to maintain flexibility.

At processing block 1004, the controller 806 will transmit a signal including
20 the updated nodeID, nodeIDL', to the listener 804. Thus, the listener 804 will maintain it's link to the controller 806 even if the listeners nodeID changes since the controller 806 will update the listener's nodeID when the controller receives the signal from talker 802 that a change has occurred. Thus, if the listener's nodeID has changed and the talker transmits a signal indicating a change of the property of the
25 connection, such as, for example, a change in the bandwidth used by the talker 802, the controller 806 will be able to forward the signal to listener 804.

It will be appreciated that all of the foregoing processing blocks are not necessary for the operation of the present invention. For example, processing block

1004 is an illustration of a signal transmitted by a talker through a maintained link between the listener 804 and controller 806.

Figure 10 is a flow diagram of another embodiment of maintaining a listeners link to a controller. Referring to **Figure 10**, at processing block 1101, a signal from a talker node 802 is received at a controller node 806. The received signal from the talker node 802 may be any type of signal transmitted by the talker 802 to a listener 804.

At processing block 1102, the controller node 806 transmits the signal from the controller 806 to a listener node 804 with an updated controller nodeID, nodeIDC', as the source nodeID. The transmitted signal will also include the controller node EUI, EUI-64C, as the source EUI.

At processing block 1103, the listener node 804 will search the listener node 804 memory for the controller node 806 EUI. At processing block 1104, the listener 804 will determine if the received controller node EUI matches an EUI in the listener node memory. At processing block 1107, if the controller node EUI does not match an EUI in the listener node memory, the listener node 804 will discard the signal at processing block 1107.

At processing block 1105, if the received controller node EUI does match an EUI in the listener node memory, the listener node 804 will determine if the received controller nodeID, nodeID64C', matches the nodeID associated with the matching EUI. At processing block 1106, if the received controller nodeID does match the nodeID associated with the match EUI, the nodeID in the listener node memory will not be updated.

If the received controller nodeID does not match the nodeID associated with the matching EUI, the stored controller nodeID, nodeIDC, will be replaced in the listener node memory with the received controller nodeID, nodeIDC', at processing block 1108.

The listener node 804 may transmit a reply signal including the updated nodeID, nodeIDC', of the controller 806 and the EUI of the controller 806 as the destination address. Thus, the link between controller 806 and listener 804 is maintained even when the controllers nodeID changes.

- 5 It will be understood that the above processes may be completed in any order, and not all of the steps are necessary for the operation of the present invention. For example, the listener node 804 may search it's memory for the received controller nodeID before the listener node searches for the controller node EUI 1103, and search for a matching EUI 1104 only if the received controller nodeID does not match a
- 10 controller nodeID in the listener nodes memory.

The specific arrangements and methods herein are merely illustrative of the principles of this invention. Numerous modifications in form and detail may be made by those skilled in the art without departing from the true spirit and scope of the invention.

CLAIMS

What is claimed is:

- 1 1. A method of maintaining communications in a bus bridge interconnect
2 comprising a plurality of buses linked by at least one bus bridge, the method
3 comprising: receiving a change indication signal from a talker node;
4 performing an address resolution protocol in response to the change
5 indication signal to find an updated node identification address("nodeID") for a
6 listener node using a extended unique identifier ("EUI") of the listener node; and
7 storing the updated listener nodeID with the listener node EUI.
- 1 2. The method of claim 1 further comprising:
2 transmitting a signal including the updated nodeID for the listener to the
3 listener.
- 1 3. The method of claim 1 wherein performing an address resolution protocol
2 comprises examining a bus bridge to see what buses exist, searching each bus until a
3 matching EUI is found, and identifying the nodeID associated with the matching
4 EUI.
- 1 4. The method of claim 1 wherein the change indication signal is a net change
2 signal.
- 1 5. The method of claim 1 wherein the buses are similar to a version of the IEEE
2 standard 1394 bus.
- 1 6. The method of claim 1 wherein the updated listener nodeID and listener node
2 EUI are stored in a bus bridge portal.

1 7. A method of maintaining communications in a bus bridge interconnect
2 comprising a plurality of buses linked by at least one bus bridge, the method
3 comprising:
4 receiving a signal from a talker node at a controller node;
5 transmitting the signal from the controller node to a listener node with an
6 updated controller nodeID as the source nodeID and the controller node EUI as the
7 source EUI;
8 searching the listener node memory for the controller node EUI;
9 comparing, if the received controller node EUI matches a stored controller
10 node EUI, the received controller nodeID to a stored controller nodeID associated
11 with the stored controller node EUI; and
12 replacing the stored controller nodeID with the received controller nodeID in
13 the listener node memory if the received controller nodeID does not match the stored
14 controller nodeID.

1 8. The method of claim 7 further comprising:
2 transmitting a reply signal including the updated nodeID and the EUI of the
3 controller node.

1 9. The method of claim 7 further comprising:
2 discarding the received message if the received controller node EUI does not
3 match a stored controller node EUI.

1 10. The method of claim 7 wherein the buses are similar to a version of the IEEE
2 standard 1394 bus.

1 11. A method of maintaining communications in a bus bridge interconnect
2 comprising a plurality of buses linked by at least one bus bridge, the method
3 comprising:
4 receiving a signal from a talker node wherein the signal includes a node
5 identification address ("nodeID") and an EUI of a controller node of the listener node;
6 searching a listener node memory for the controller node EUI;
7 comparing, if the received controller node EUI matches a stored controller
8 node EUI, the received controller nodeID to a stored controller nodeID
9 corresponding to the stored controller node EUI; and
10 replacing the stored controller nodeID with the received controller nodeID if
11 the received controller nodeID does not match the stored controller nodeID.

1 12. The method of claim 11 further comprising:
2 transmitting a reply signal including the updated nodeID and the EUI of the
3 controller node.

1 13. The method of claim 11 further comprising:
2 discarding the received message if the received controller node EUI does not
3 match a stored controller node EUI.

1 14. The method of claim 11 wherein the buses are similar to a version of the IEEE
2 standard 1394 bus.

1 15. An apparatus comprising:
2 means for receiving a change indication signal from a talker node;
3 means for performing an address resolution protocol in response to the
4 change indication signal to find an updated a node identification address("nodeID")

for a listener node using a extended unique identifier ("EUI") of the listener node;
and
means for storing the updated listener nodeID with the listener node EUI.

16. An apparatus comprising:

means for receiving a signal from a talker node at a controller node;
means for transmitting the signal from the controller node to a listener node
with an updated controller nodeID as the source nodeID and the controller node EUI
as the source EUI;
means for searching the listener node memory for the controller node EUI;
means for comparing, if the received controller node EUI matches a stored
controller node EUI, the received controller nodeID to a stored controller nodeID
associated with the stored controller node EUI; and
means for replacing the stored controller nodeID with the received controller
nodeID in the listener node memory if the received controller nodeID does not match
the stored controller nodeID.

17. An apparatus comprising:

means for receiving a signal from a talker node wherein the signal includes a
node identification address ("nodeID") and an EUI of a controller node of the listener
node;
means for searching a listener node memory for the controller node EUI;
means for comparing, if the received controller node EUI matches a stored
controller node EUI, the received controller nodeID to a stored controller nodeID
corresponding to the stored controller node EUI; and
means for replacing the stored controller nodeID with the received controller
nodeID if the received controller nodeID does not match the stored controller
nodeID.

1 18. A machine-readable medium having stored thereon instructions, which when
2 executed by a set of processors, cause said set of processors to perform the following:
3 receive a change indication signal from a talker node;
4 perform an address resolution protocol in response to the change indication
5 signal to find an updated a node identification address("nodeID") for a listener node
6 using a extended unique identifier ("EUI") of the listener node; and
7 store the updated listener nodeID with the listener node EUI.
8

9 19. A machine-readable medium having stored thereon instructions, which when
10 executed by a set of processors, cause said set of processors to perform the following:
11 receive a signal from a talker node at a controller node;
12 transmit the signal from the controller node to a listener node with an updated
13 controller nodeID as the source nodeID and the controller node EUI as the source
14 EUI;
15 search the listener node memory for the controller node EUI;
16 compare, if the received controller node EUI matches a stored controller node
17 EUI, the received controller nodeID to a stored controller nodeID associated with the
18 stored controller node EUI; and
19 replace the stored controller nodeID with the received controller nodeID in the
20 listener node memory if the received controller nodeID does not match the stored
21 controller nodeID.
22

23 20. A machine-readable medium having stored thereon instructions, which when
24 executed by a set of processors, cause said set of processors to perform the following:
25 receive a signal from a talker node wherein the signal includes a node
26 identification address ("nodeID") and an EUI of a controller node of the listener node;
27 search a listener node memory for the controller node EUI;

28 compare, if the received controller node EUI matches a stored controller node
29 EUI, the received controller nodeID to a stored controller nodeID corresponding to
30 the stored controller node EUI; and
31 replace the stored controller nodeID with the received controller nodeID if the
32 received controller nodeID does not match the stored controller nodeID.

ABSTRACT

A method of maintaining communications in a bus bridge interconnect including a plurality of buses linked by at least one bus bridge. The method includes receiving a change indication signal from a talker node, performing an address resolution protocol in response to the change indication signal to find an updated node identification address("nodeID") for a listener node using an extended unique identifier ("EUI") of the listener node, and storing the updated listener nodeID with the listener node EUI.

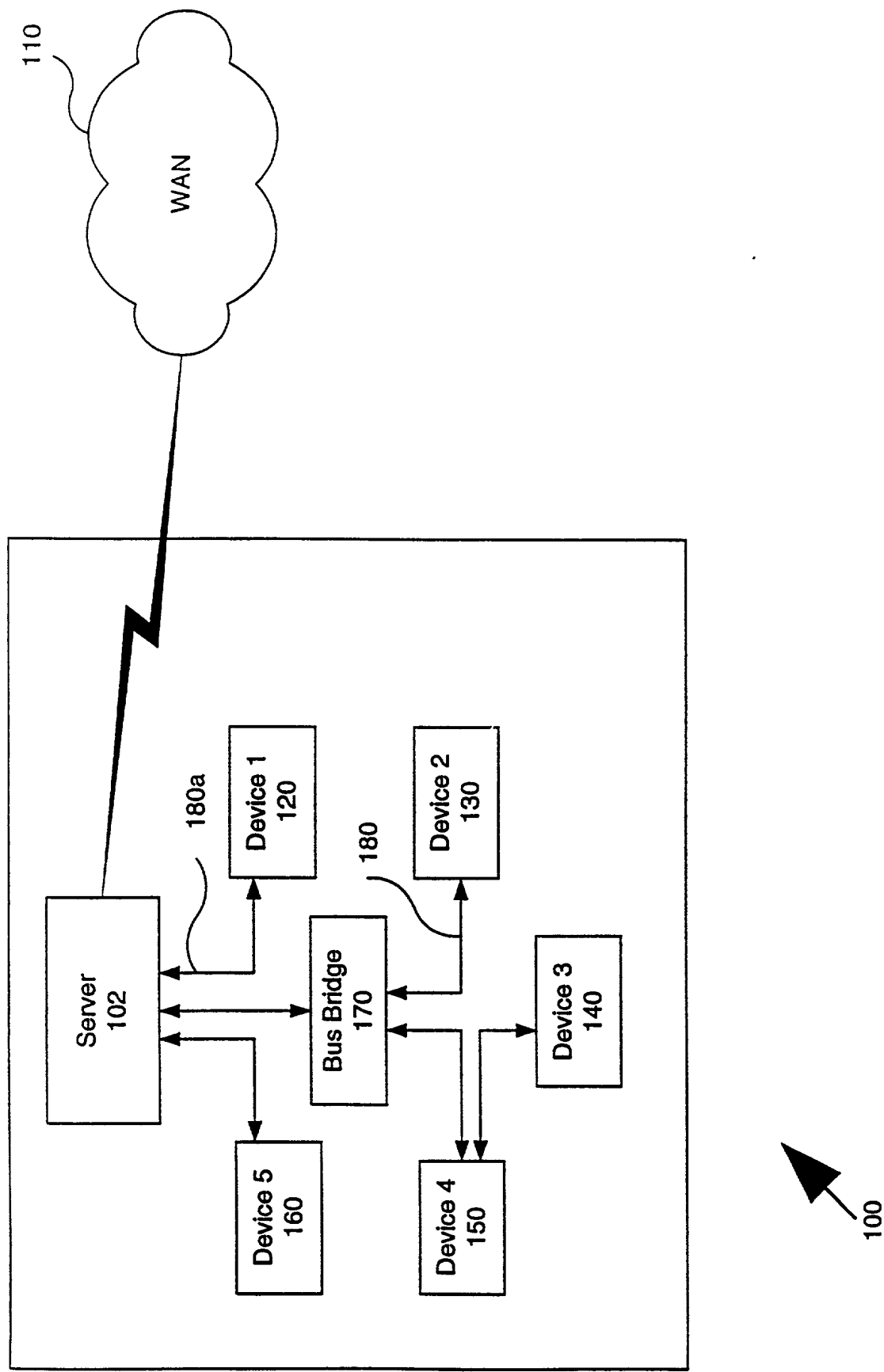


Figure 1

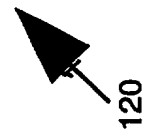
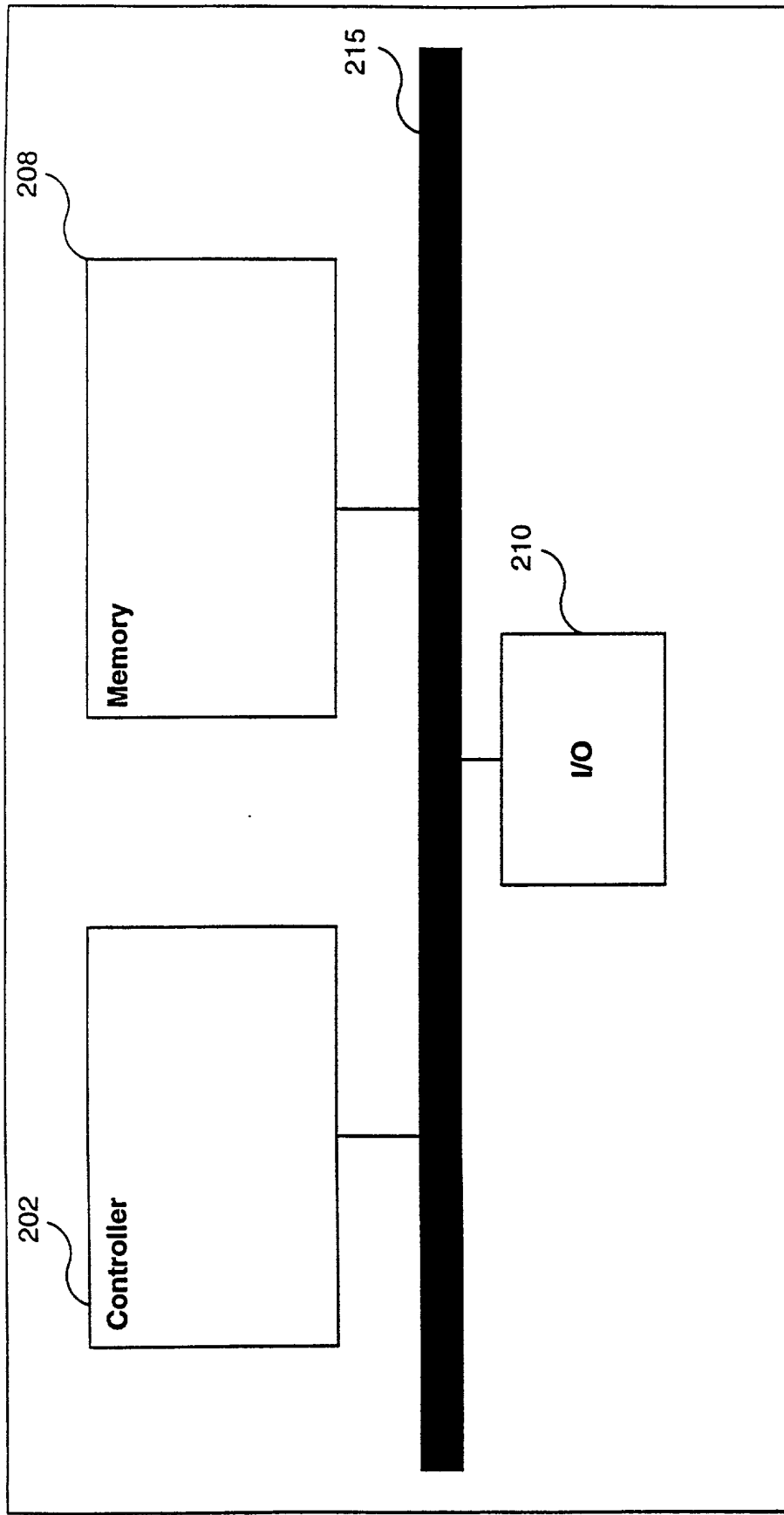


Figure 2

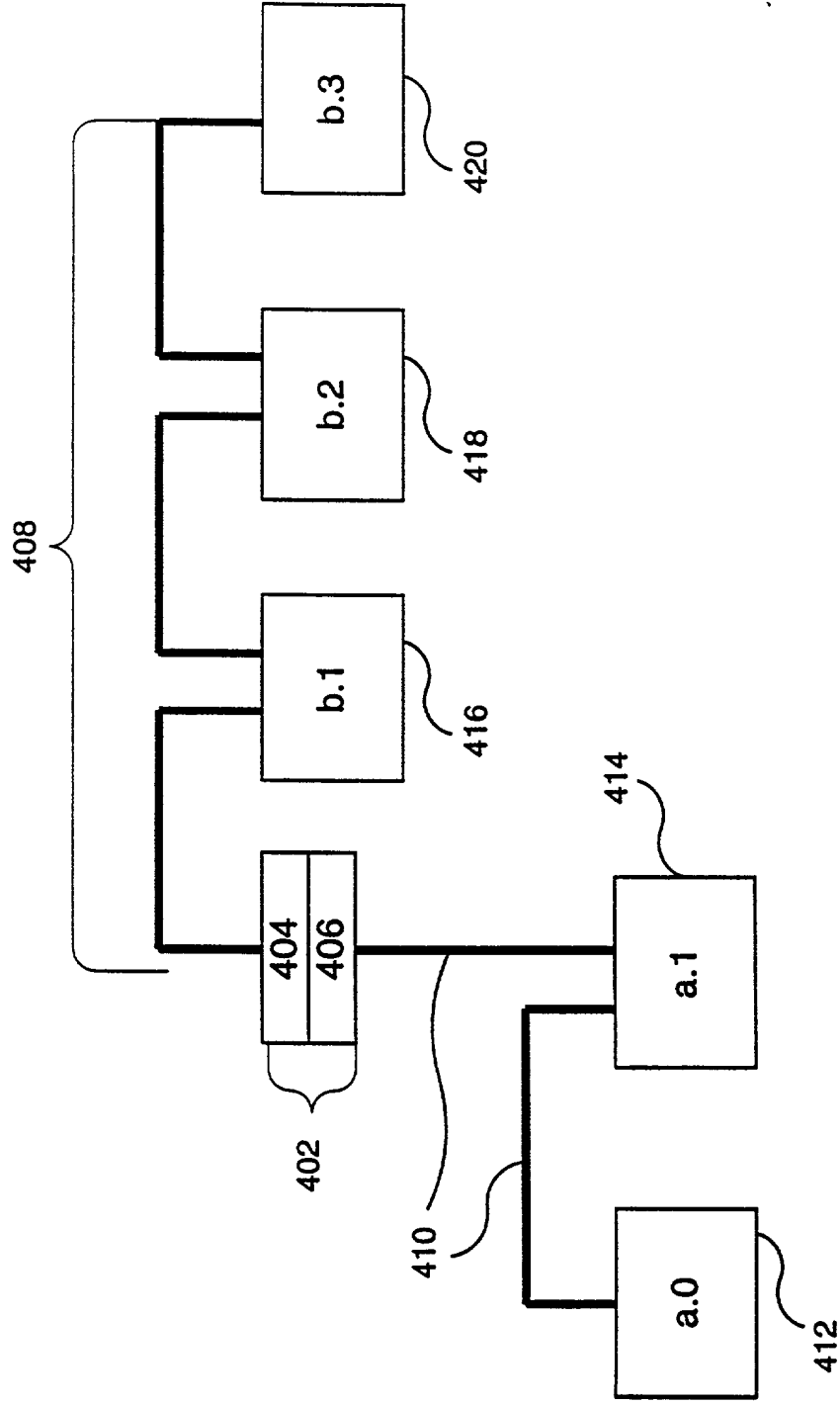


Figure 3

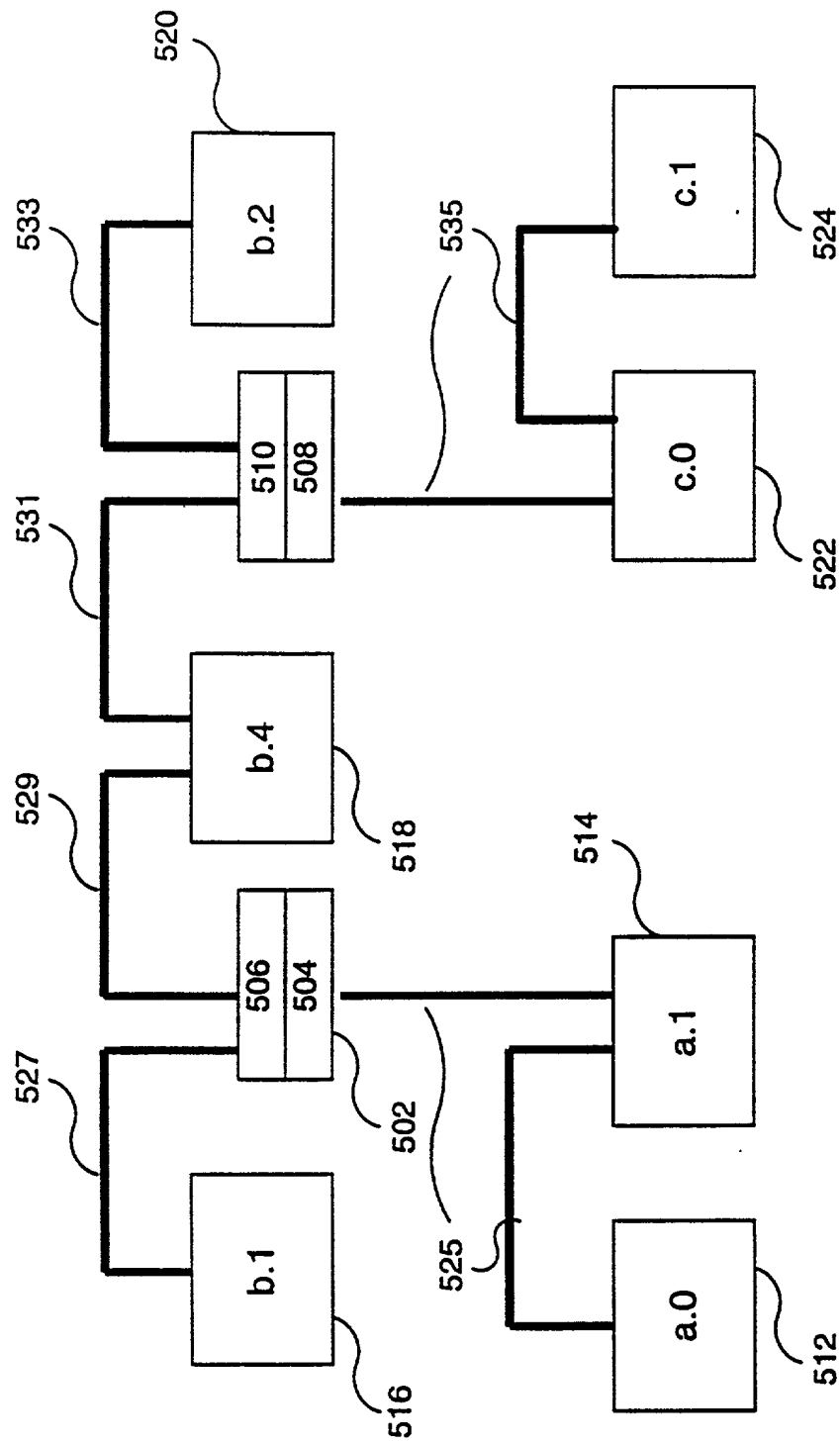


Figure 4

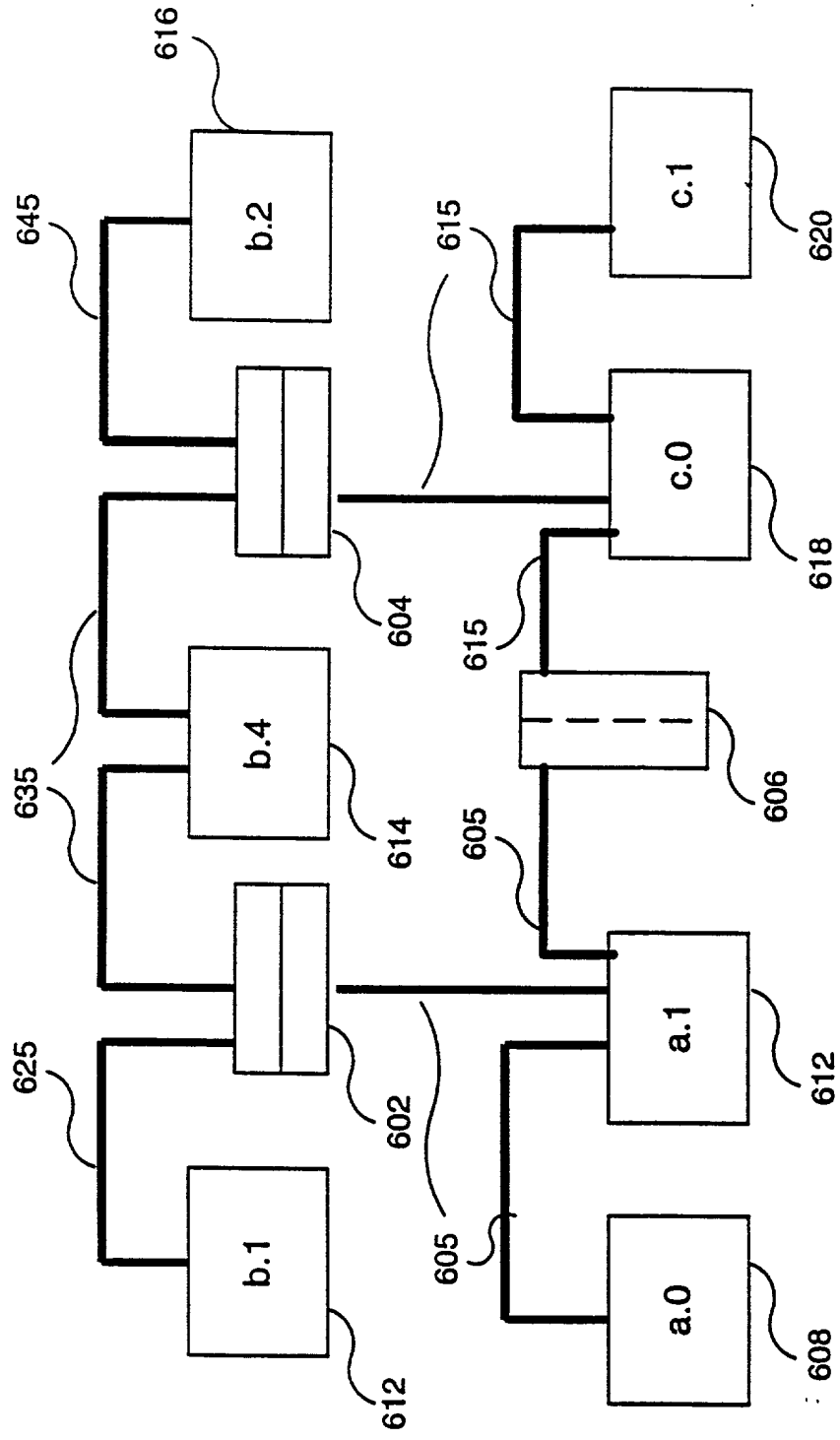
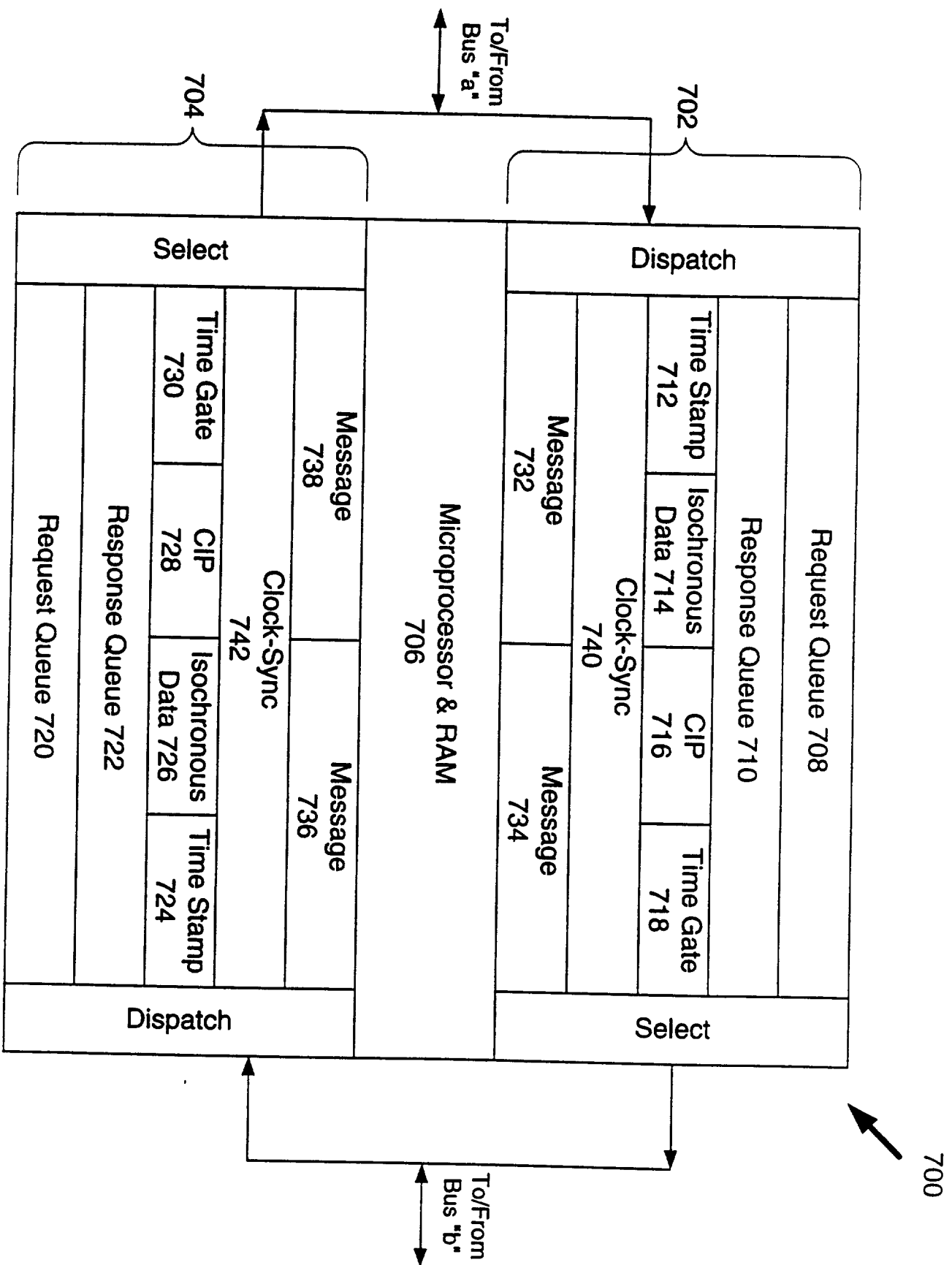


Figure 5



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Figure 6

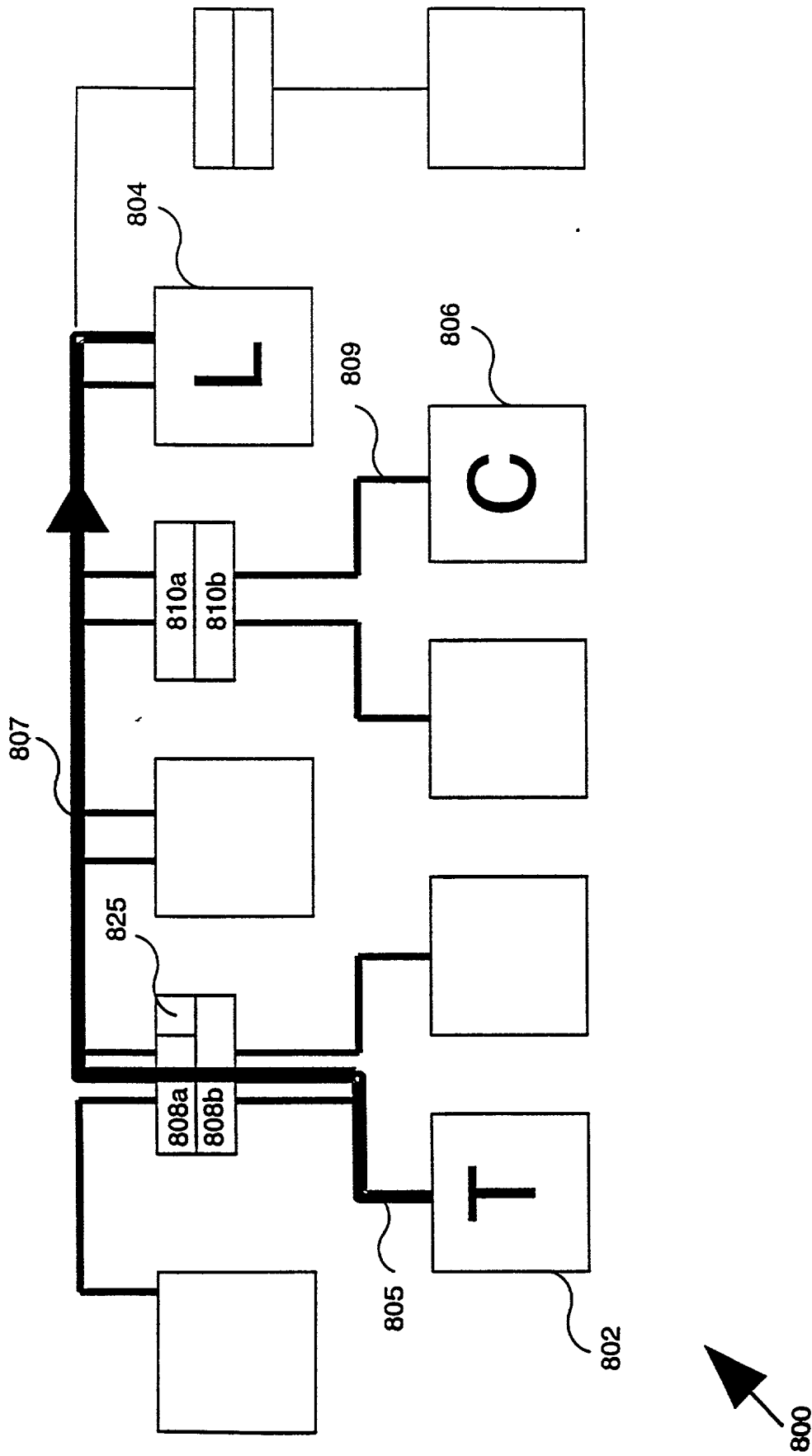


Figure 7

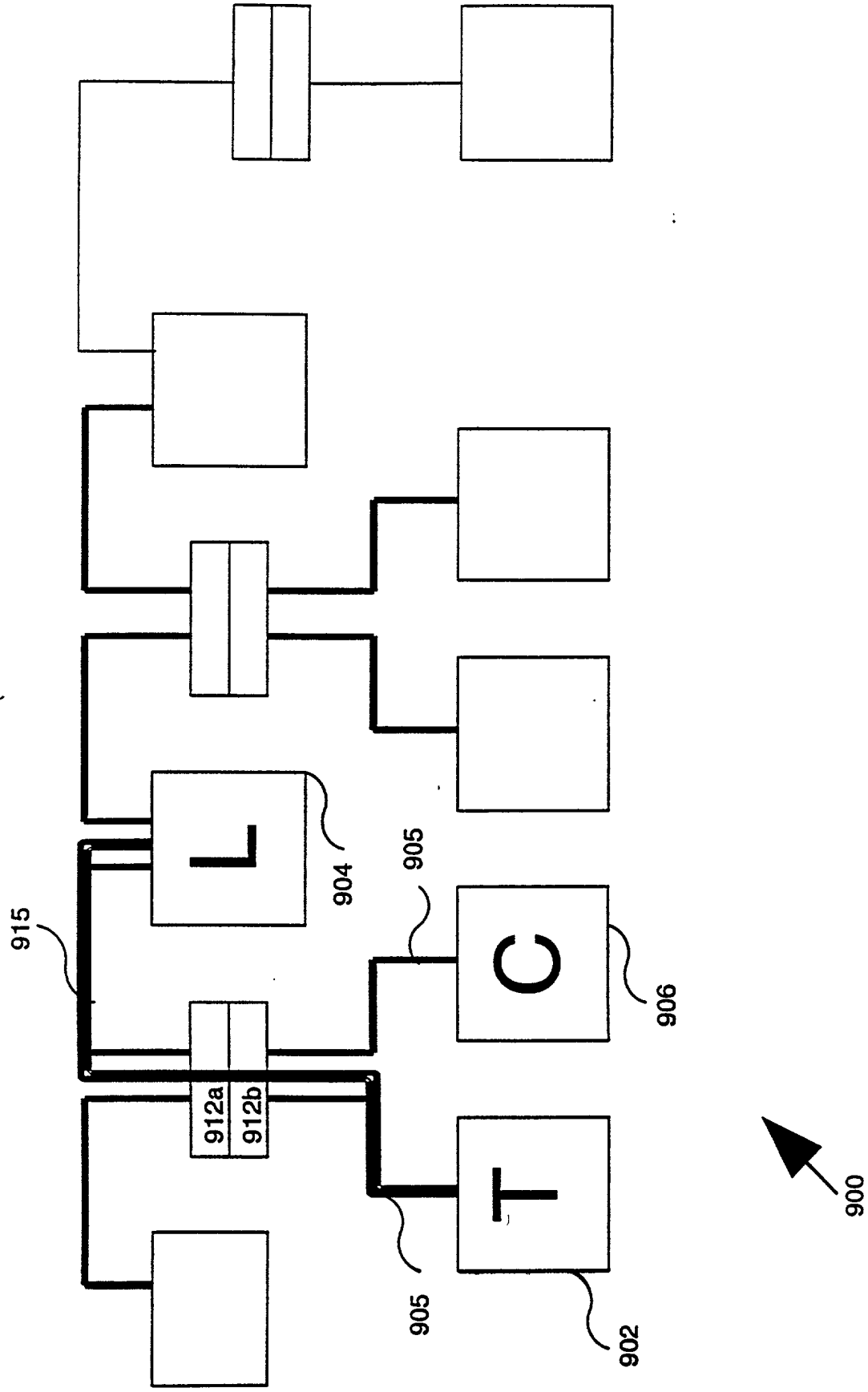


Figure 8

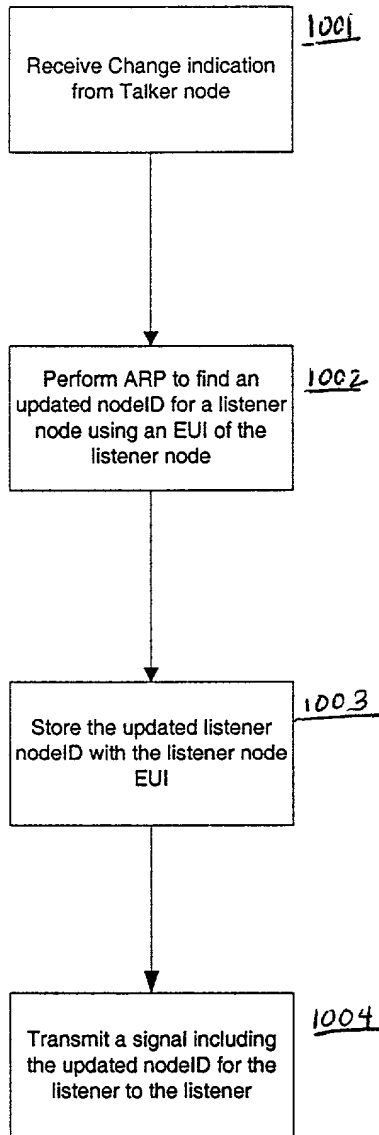


FIGURE 9

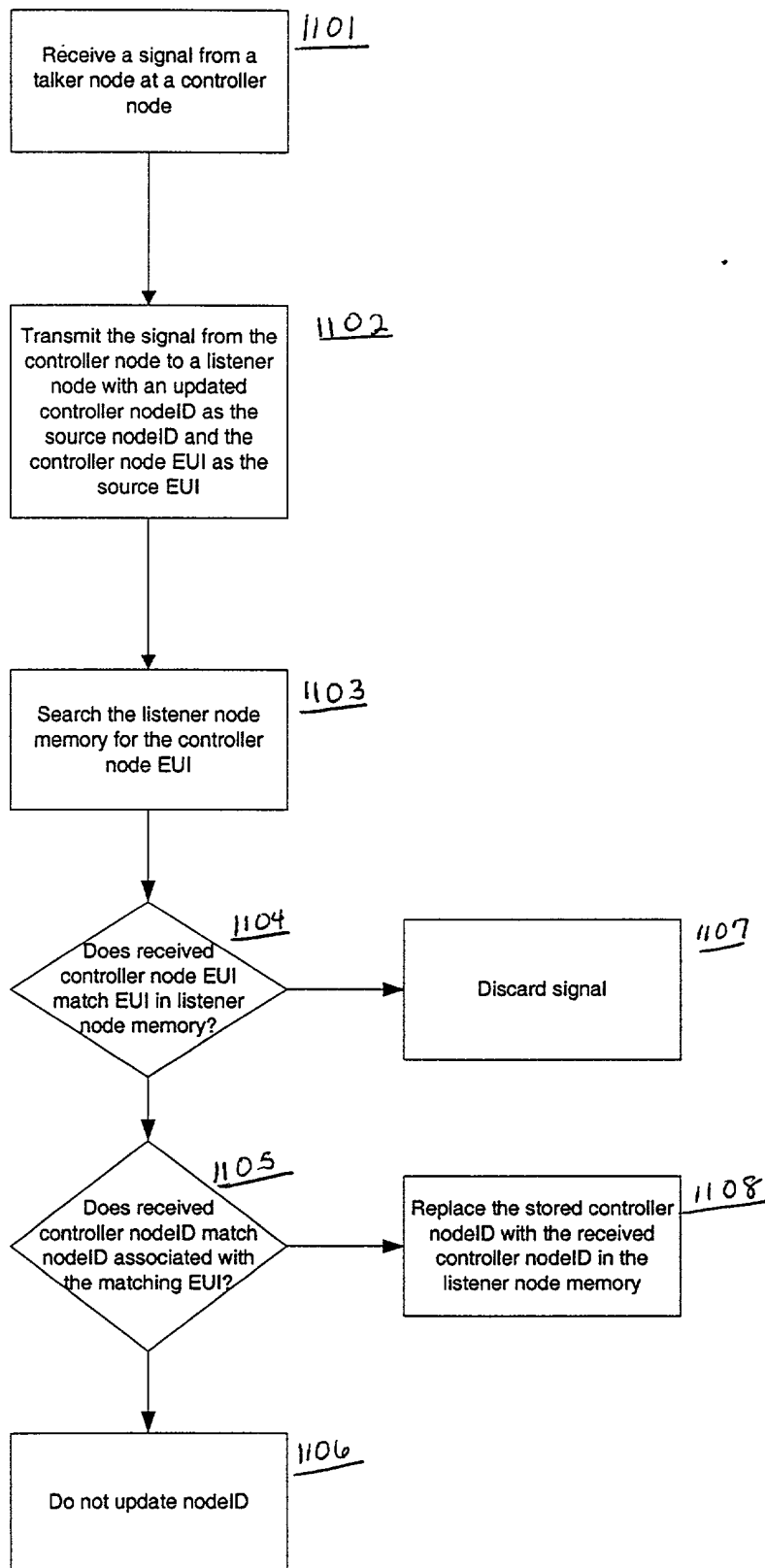


FIGURE 10

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

A Method and System for Maintaining a Listener's Link to a Controller

the specification of which

XXX is attached hereto.

 was filed on _____ as

United States Application Number _____

or PCT International Application Number _____

and was amended on _____.

(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I do not know and do not believe that the claimed invention was ever known or used in the United States of America before my invention thereof, or patented or described in any printed publication in any country before my invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, and that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (for a utility patent application) or six months (for a design patent application) prior to this application.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d), of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Priority
Claimed

(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
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<u>60/155.305</u>	<u>9/21/99</u>
(Application Number)	Filing Date

(Application Number)	Filing Date
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(Application Number)	Filing Date	(Status -- patented, pending, abandoned)
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(Application Number)	Filing Date	(Status -- patented, pending, abandoned)
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(Name of Attorney or Agent)

ZAFMAN LLP, 12400 Wilshire Boulevard 7th Floor, Los Angeles, California 90025 and direct telephone calls to Maria McCormack Sobrino, (408) 720-8300.
(Name of Attorney or Agent)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Inventor's Signature _____ Date _____

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(City, State) (Country)

Post Office Address _____

APPENDIX A

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APPENDIX B

Title 37, Code of Federal Regulations, Section 1.56 Duty to Disclose Information Material to Patentability

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

- (1) Prior art cited in search reports of a foreign patent office in a counterpart application, and
 - (2) The closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.
- (b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made of record in the application, and
- (1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or
 - (2) It refutes, or is inconsistent with, a position the applicant takes in:
 - (i) Opposing an argument of unpatentability relied on by the Office, or
 - (ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

- (1) Each inventor named in the application;
 - (2) Each attorney or agent who prepares or prosecutes the application; and
 - (3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.
- (d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.